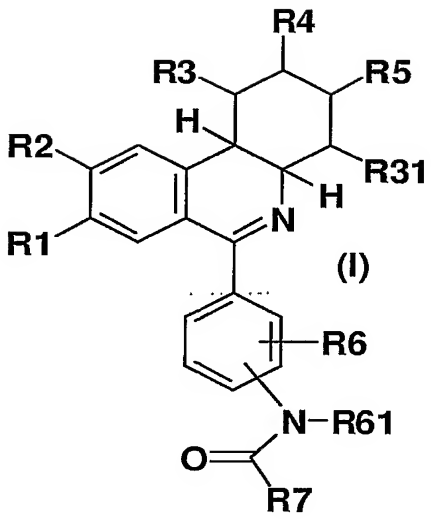
Patent Claims

1. Compounds of formula I,



in which

R1 is hydroxyl, 1-4C-alkoxy, 3-7C-cycloalkoxy, 3-7C-cycloalkylmethoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-4C-alkoxy,

R2 is hydroxyl, 1-4C-alkoxy, 3-7C-cycloalkoxy, 3-7C-cycloalkylmethoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-4C-alkoxy,

or in which

R1 and R2 together are a 1-2C-alkylenedioxy group,

R3 is hydrogen or 1-4C-alkyl,

R31 is hydrogen or 1-4C-alkyl,

either, in a first embodiment (embodiment a) according to the present invention,

R4 is -O-R41, in which

R41 is hydrogen, 1-4C-alkyl, 1-4C-alkoxy-1-4C-alkyl, hydroxy-2-4C-alkyl, 1-7C-alkylcarbonyl, or completely or predominantly fluorine-substituted 1-4C-alkyl, and

R5 is hydrogen or 1-4C-alkyl,

or, in a second embodiment (embodiment b) according to the present invention,

R4 is hydrogen or 1-4C-alkyl, and

R5 is -O-R51, in which

R51 is hydrogen, 1-4C-alkyl, 1-4C-alkoxy-1-4C-alkyl, hydroxy-2-4C-alkyl, 1-7C-alkylcarbonyl, or completely or predominantly fluorine-substituted 1-4C-alkyl,

R6 is hydrogen, halogen, 1-4C-alkyl or 1-4C-alkoxy,

R61 is hydrogen, 1-4C-alkyl or 1-4C-alkoxy-2-4C-alkyl,

R7 is Het1, Har1, 3-7C-cycloalkyl, or 1-4C-alkyl substituted by R8, in which

Het1 is optionally substituted by R71 and is a monocylic 3- to 7-membered fully saturated heterocyclic ring radical,
which is bonded via a ring carbon atom to the carbonyl moiety of the -C(O)N(R61)- group, and
which comprises one nitrogen atom and optionally one further heteroatom selected from the group consisting of nitrogen, oxygen and sulfur, and, optionally,
to which ring one or two oxo groups are bonded, in which

R71 is 1-4C-alkyl, or completely or partially fluorine-substituted 1-4C-alkyl,

Har1 is optionally substituted by R72 and/or R73, and is a 5- or 6-membered monocyclic unsaturated heteroaryl radical comprising 1 to 4 heteroatoms selected independently from the group consisting of oxygen, nitrogen and sulfur, in which

R72 is halogen, 1-4C-alkyl, 1-4C-alkoxy, 1-4C-alkoxy-2-4C-alkoxy, 1-4C-alkylthio, cyano, 1-4C-alkoxycarbonyl, carboxyl, hydroxyl, -A-N(R721)R722, pyridyl, or completely or partially fluorine-substituted 1-4C-alkyl, in which

A is a bond or 1-4C-alkylene,

R721 is hydrogen or 1-4C-alkyl,

R722 is hydrogen or 1-4C-alkyl,

or R721 and R722 together and with inclusion of the nitrogen atom, to which they are attached, form a heterocyclic ring Het2, in which

Het2 is optionally substituted by R723, and is a 3- to 7-membered saturated or unsaturated monocyclic heterocyclic ring radical comprising the nitrogen atom, to which R721 and R722 are bonded, and optionally one to three further heteroatoms independently selected from the group consisting of oxygen, nitrogen and sulfur, in which

R723 is 1-4C-alkyl,

R73 is halogen, 1-4C-alkoxy, 1-4C-alkoxy-2-4C-alkoxy, 1-4C-alkylthio, hydroxyl, amino or mono- or di-1-4C-alkylamino,

R8 is 1-4C-alkoxy, carbamoyl, carboxyl, 1-4C-alkoxycarbonyl, mono- or di-1-4C-alkylaminocarbonyl or -N(R81)R82, in which

R81 is hydrogen, 1-4C-alkyl, carbamoyl, amidino or 1-4C-alkylcarbonyl,

R82 is hydrogen or 1-4C-alkyl,

or R81 and R82 together and with inclusion of the nitrogen atom, to which they are attached, form a heterocyclic ring Het3, in which

Het3 is optionally substituted by R811, and is a 3- to 7-membered saturated monocyclic heterocyclic ring radical comprising the nitrogen atom, to which R81 and R82 are bonded, and optionally one further heteroatom selected from the group consisting of oxygen, nitrogen and sulfur, in which

R811 is 1-4C-alkyl,

and the salts, the N-oxides and the salts of the N-oxides of these compounds.

2. Compounds of formula I according to claim 1 in which

R1 is 1-2C-alkoxy, 3-5C-cycloalkoxy, 3-5C-cycloalkylmethoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-2C-alkoxy,

R2 is 1-2C-alkoxy, 3-5C-cycloalkoxy, 3-5C-cycloalkylmethoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-2C-alkoxy,

R3 is hydrogen,

R31 is hydrogen,

either, in a first embodiment (embodiment a) according to the present invention,

R4 is -O-R41, in which

R41 is hydrogen or 1-4C-alkylcarbonyl, and

R5 is hydrogen,

or, in a second embodiment (embodiment b) according to the present invention,

R4 is hydrogen, and

R5 is -O-R51, in which

R51 is hydrogen or 1-4C-alkylcarbonyl,

R6 is hydrogen,

R61 is hydrogen,

R7 is Het1, Har1, 3-7C-cycloalkyl, or 1-4C-alkyl substituted by R8, in which

Het1 is optionally substituted by R71 and is a monocylic 5- to 7-membered fully saturated heterocyclic ring radical,

which is bonded via a ring carbon atom to the carbonyl moiety of the -C(O)N(R61)- group, and

which comprises one nitrogen atom and optionally one further heteroatom selected from the group consisting of nitrogen, oxygen and sulfur, and, optionally,

to which ring one or two oxo groups are bonded, in which

R71 is 1-4C-alkyl, or completely or partially fluorine-substituted 1-4C-alkyl,

Har1 is optionally substituted by R72 and/or R73, and is

either a 6-membered monocyclic unsaturated heteroaryl radical comprising one or two nitrogen atoms,

or a 5-membered monocyclic unsaturated heteroaryl radical comprising 1 to 4 heteroatoms selected independently from the group consisting of oxygen, nitrogen and sulfur, in which

R72 is halogen, 1-4C-alkyl, 1-4C-alkoxy, 1-4C-alkoxy-2-4C-alkoxy, 1-4C-alkylthio, cyano, 1-4C-alkoxycarbonyl, carboxyl, hydroxyl, -A-N(R721)R722, pyridyl, or completely or partially fluorine-substituted 1-4C-alkyl, in which

A is a bond or 1-4C-alkylene,

R721 is hydrogen or 1-4C-alkyl,

R722 is hydrogen or 1-4C-alkyl,

or R721 and R722 together and with inclusion of the nitrogen atom, to which they are attached, form a heterocyclic ring Het2, in which

Het2 is optionally substituted by R723, and is a 3- to 7-membered saturated or unsaturated monocyclic heterocyclic ring radical comprising the nitrogen atom, to which R721 and R722 are bonded, and optionally one to three further heteroatoms independently selected from the group consisting of oxygen, nitrogen and sulfur, in which

R723 is 1-4C-alkyl,

R73 is halogen, 1-4C-alkoxy, 1-4C-alkoxy-2-4C-alkoxy, 1-4C-alkylthio, hydroxyl, amino or mono- or di-1-4C-alkylamino,

R8 is 1-4C-alkoxy, carbamoyl, mono- or di-1-4C-alkylaminocarbonyl or -N(R81)R82, in which

R81 is hydrogen, 1-4C-alkyl, carbamoyl, amidino or 1-4C-alkylcarbonyl,

R82 is hydrogen or 1-4C-alkyl,

or R81 and R82 together and with inclusion of the nitrogen atom, to which they are attached, form a heterocyclic ring Het3, in which

Het3 is optionally substituted by R811, and is a 3- to 7-membered saturated monocyclic heterocyclic ring radical comprising the nitrogen atom, to which R81 and R82 are bonded, and optionally one further heteroatom selected from the group consisting of oxygen, nitrogen and sulfur, in which

R811 is 1-4C-alkyl,

and the salts, the N-oxides and the salts of the N-oxides of these compounds.

3. Compounds of formula I according to claim 1 in which

R1 is 1-2C-alkoxy, 3-5C-cycloalkoxy, 3-5C-cycloalkylmethoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-2C-alkoxy,

R2 is 1-2C-alkoxy, 3-5C-cycloalkoxy, 3-5C-cycloalkylmethoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-2C-alkoxy,

R3 is hydrogen,

R31 is hydrogen,

R4 is -O-R41, in which

R41 is 1-4C-alkylcarbonyl or hydrogen,

R5 is hydrogen,

R6 is hydrogen,

R61 is hydrogen,

R7 is Het1, Har1, 3-7C-cycloalkyl, or 1-4C-alkyl substituted by R8, in which

Het1 is optionally substituted by R71 and is a monocylic 5- to 7-membered fully saturated heterocyclic ring radical,
which is bonded via a ring carbon atom to the carbonyl moiety of the -C(O)N(R61)- group, and
which comprises one nitrogen atom, and, optionally,
to which ring one oxo group is bonded, in which

R71 is 1-4C-alkyl, or completely or partially fluorine-substituted 1-2C-alkyl,

Har1 is optionally substituted by R72 and/or R73, and is
a 6-membered monocyclic unsaturated heteroaryl radical comprising one or two nitrogen atoms, in which

R72 is halogen, 1-4C-alkoxy, 1-4C-alkoxy-ethoxy, 1-2C-alkylthio, hydroxyl, amino or mono- or di-1-2C-alkylamino,

R73 is halogen, 1-4C-alkoxy, 1-2C-alkoxy-ethoxy, 1-2C-alkylthio, hydroxyl, amino or mono- or di-1-2C-alkylamino,

R8 is 1-4C-alkoxy, carbamoyl, mono- or di-1-4C-alkylaminocarbonyl or -N(R81)R82, in which

R81 is hydrogen, 1-4C-alkyl, carbamoyl or 1-4C-alkylcarbonyl,

R82 is hydrogen or 1-4C-alkyl,

or R81 and R82 together and with inclusion of the nitrogen atom, to which they are attached, form a heterocyclic ring Het3, in which

Het3 is optionally substituted by R811, and is a 3- to 7-membered saturated monocyclic heterocyclic ring radical comprising the nitrogen atom, to which R81 and R82 are bonded, and optionally one further heteroatom selected from the group consisting of oxygen, nitrogen and sulfur, in which

R811 is 1-2C-alkyl,

and the salts, the N-oxides and the salts of the N-oxides of these compounds.

4. Compounds of formula I according to claim 1 in which

R1 is 1-2C-alkoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-2C-alkoxy,

R2 is 1-2C-alkoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-2C-alkoxy,

R3 is hydrogen,

R31 is hydrogen,

R4 is -O-R41, in which

R41 is hydrogen,

R5 is hydrogen,

R6 is hydrogen,

R61 is hydrogen,

R7 is Het1, Har1, 3-5C-cycloalkyl, or 1-4C-alkyl substituted by R8, in which

Het1 is 1-N-(R71)-piperdin-4-yl or pyrrolidin-2-on-5-yl, in which

R71 is 1-4C-alkyl,

Har1 is optionally substituted by R72 and/or R73, and is pyridinyl, in which

R72 is 1-4C-alkoxy,

R73 is 1-4C-alkoxy,

R8 is 1-4C-alkoxy, carbamoyl, mono- or di-1-4C-alkylaminocarbonyl or -N(R81)R82, in which

R81 is 1-4C-alkyl, carbamoyl or 1-4C-alkylcarbonyl,

R82 is hydrogen or 1-4C-alkyl,

or R81 and R82 together and with inclusion of the nitrogen atom, to which they are attached, form a heterocyclic ring Het3, in which

Het3 is piperidin-1-yl, pyrrolidin-1-yl, 4-N-(R811)-piperazin-1-yl, 4-N-(R811)-homopiperazin-1-yl, homopiperidin-1-yl, morpholin-4-yl or thiomorpholin-4-yl, in which

R811 is 1-2C-alkyl,

and the salts, the N-oxides and the salts of the N-oxides of these compounds.

5. Compounds of formula I according to claim 1 in which

R1 is 1-2C-alkoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-2C-alkoxy,

R2 is 1-2C-alkoxy, 2,2-difluoroethoxy, or completely or predominantly fluorine-substituted 1-2C-alkoxy,

R3 is hydrogen,

R31 is hydrogen,

R4 is -O-R41, in which

R41 is hydrogen,

R5 is hydrogen,

R6 is hydrogen,

R61 is hydrogen,

R7 is Het1, Har1, 3-5C-cycloalkyl, or 1-4C-alkyl substituted by R8, in which

Het1 is 1-N-(R71)-piperdin-4-yl or pyrrolidin-2-on-5-yl, in which

R71 is 1-4C-alkyl,

Har1 is 2,6-dimethoxypyridin-3-yl,

R8 is 1-4C-alkoxy, carbamoyl, mono- or di-1-4C-alkylaminocarbonyl or -N(R81)R82, in which

R81 is 1-4C-alkyl, carbamoyl or 1-4C-alkylcarbonyl,

R82 is hydrogen or 1-4C-alkyl,

or R81 and R82 together and with inclusion of the nitrogen atom, to which they are attached, form a heterocyclic ring Het3, in which

Het3 is piperidin-1-yl,

and the salts, the N-oxides and the salts of the N-oxides of these compounds.

6. Compounds of formula I according to claim 1 in which
R1 is methoxy or ethoxy,
R2 is methoxy, ethoxy, difluoromethoxy or 2,2-difluoroethoxy,
R3 is hydrogen,
R31 is hydrogen,

R4 is -O-R41, in which
R41 is hydrogen,
R5 is hydrogen,

R6 is hydrogen,
R61 is hydrogen,

R7 is Het1, Har1, cyclopropyl, or 1-4C-alkyl substituted by R8, in which
Het1 is 1-N-(R71)-piperdin-4-yl or pyrrolidin-2-on-5-yl, in which
R71 is methyl,

Har1 is 2,6-dimethoxypyridin-3-yl,

R8 is methoxy, carbamoyl, dimethylaminocarbonyl or -N(R81)R82, in which
R81 is methyl, carbamoyl or acetyl,
R82 is hydrogen or methyl,
or R81 and R82 together and with inclusion of the nitrogen atom, to which they are attached, form a heterocyclic ring Het3, in which
Het3 is piperidin-1-yl,
and the salts, the N-oxides and the salts of the N-oxides of these compounds.

7. Compounds of formula I according to any of the preceding claims comprising one or more of the following:
R1 is methoxy,
R2 is methoxy, ethoxy, difluoromethoxy or 2,2-difluoroethoxy, and
R3 and R31 are hydrogen;

R4 is -O-R41, in which
R41 is hydrogen, and

R5 is hydrogen;

R6 is hydrogen;

R61 is hydrogen; and

the radical R7C(O)N(R61)- is bonded to the meta or para position with respect to the binding position, in which the phenyl group is bonded to the phenanthridine ring system;

and the salts, the N-oxides and the salts of the N-oxides of these compounds.

8. Compounds of formula I according to claim 1 selected from

N-[3-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-2-methoxy-acetamide

N-[4-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-3-methoxy-propionamide

Cyclopropanecarboxylic acid [3-((2RS,4aRS,10bRS)-9-ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-amide

N-[4-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-3-piperidin-1-yl-propionamide

N-[4-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-N',N'-dimethyl-succinamide

1-Methyl-piperidine-4-carboxylic acid [4-((2RS,4aRS,10bRS)-9-ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-amide

Cyclopropanecarboxylic acid [4-((2RS,4aRS,10bRS)-9-ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-amide

N-[3-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-3-methoxy-propionamide

N-[4-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-2-methoxy-acetamide

N-[3-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-3-piperidin-1-yl-propionamide

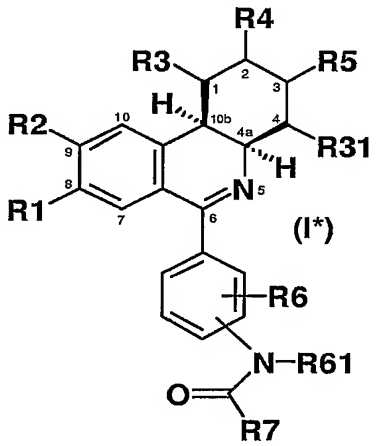
1-Methyl-piperidine-4-carboxylic acid [3-((2RS,4aRS,10bRS)-9-ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-amide

N-[3-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-N',N'-dimethyl-succinamide

Dimethylamino-N-[4-((2RS,4aRS,10bRS)-9-ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-butyramide

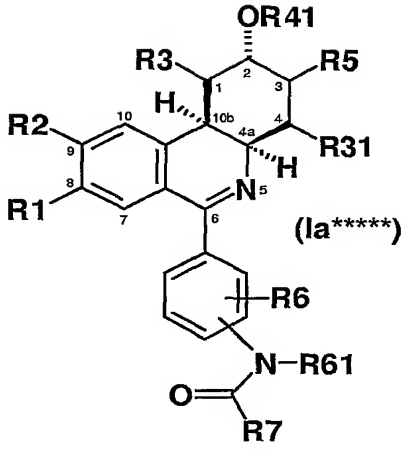
Dimethylamino-N-[3-((2RS,4aRS,10bRS)-9-ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-butyramide
2-Acetylamino-N-[3-((2RS,4aRS,10bRS)-9-ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-acetamide
5-Oxo-pyrrolidine-2-carboxylic acid [3-((2RS,4aRS,10bRS)-9-ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-amide
N-[3-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-2,6-dimethoxy-nicotinamide
(2RS,4aRS,10bRS)-6-[3-(3-carbamoyl-propanoylamino)-phenyl]-9-ethoxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-2-ol
N-[3-((2RS,4aRS,10bRS)-9-Ethoxy-2-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-3-ureido-propionamide and
Cyclopropanecarboxylic acid [3-((3SR,4aRS,10bRS)-9-ethoxy-3-hydroxy-8-methoxy-1,2,3,4,4a,10b-hexahydro-phenanthridin-6-yl)-phenyl]-amide
the enantiomers, as well as the salts, the N-oxides and the salts of the N-oxides of these compounds and enantiomers.

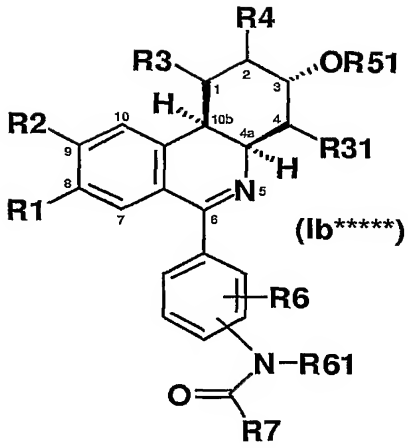
9. Compounds of formula I according to any of the preceding claims, which have with respect to the positions 4a and 10b the configuration shown in formula I*:



and the salts, the N-oxides and the salts of the N-oxides of these compounds.

10. Compounds of formula I according to any of the preceding claims, which have with respect to the positions 2, 4a and 10b the configuration shown in formula Ia*****, or, which have with respect to the positions 3, 4a and 10b the configuration shown in formula Ib*****:





and the salts, the N-oxides and the salts of the N-oxides of these compounds.

11. Compounds of formula I as claimed in claim 1 for use in the treatment of diseases.

12. A pharmaceutical composition comprising one or more compounds of formula I as claimed in claim 1 together with customary pharmaceutical excipients and/or vehicles.

13. The use of compounds of formula I as claimed in claim 1 for the production of pharmaceutical compositions for treating respiratory disorders.

14. The use of compounds of formula I as claimed in claim 1 for the production of pharmaceutical compositions for treating PDE-mediated disorders.

15. A method for treating illnesses in a patient comprising administering to said patient a therapeutically effective amount of a compound of formula I as claimed in claim 1.

16. A method for treating airway disorders in a patient comprising administering to said patient a therapeutically effective amount of a compound of formula I as claimed in claim 1.